UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/805,811	03/22/2004	Kevin T. Marks	016295.1576	1073

7590 07/09/2008

Roger Fulghum
Baker Botts L.L.P.
One Shell Plaza
910 Louisiana Street
Houston, TX 77002-4995

EXAMINER	
WALTER, CRAIG E	

ART UNIT	PAPER NUMBER
2188	

NOTIFICATION DATE	DELIVERY MODE
07/09/2008	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

Office Action Summary	Application No.	Applicant(s)	
	10/805,811	MARKS ET AL.	
	Examiner	Art Unit	
	CRAIG E. WALTER	2188	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 May 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2,4-6,9-12,14 and 16-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1, 2, 4-6, 9-12, 14 and 16-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *5/27/08*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 27 May 2008 has been entered.

Status of Claims

2. Claims 1, 2, 4-6, 9-12, 14 and 16-20 are pending in the Application.

Claims 3, 7, 8, 13 and 15 are cancelled.

Claims 1, 5, 10, 16 and 18 are amended.

Claims 1, 2, 4-6, 9-12, 14 and 16-20 are rejected.

Response to Amendment

3. Applicant's amendments and arguments filed on 27 May 2008 in response to the Office action mailed on 29 January 2008 have been considered but they moot in view of the new grounds of rejection necessitated by amendment.

Information Disclosure Statement

4. The information disclosure statement filed 27 May has been fully considered by Examiner.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 1, 2, 4, 10-12, 14 and 16-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Horst et al. (US Patent 6,567,892 B1), hereinafter "Horst", in view of Bogin et al. (US PG Publication 2004/0024971 A1), hereinafter "Bogin".

As for claim 1, Horst teaches a method for managing rebuild commands directed from a drive controller to a drive (Fig. 1, element 110), the drive having a first non-volatile memory and a cache (Fig. 1, element 132), the drive controller having a non-volatile second memory (Fig. 1, elements 126, 128, 180);

enabling the cache of the drive (col. 7, lines 35-52 – the cache is enabled);

recording in the second memory of the drive controller each rebuild command directed to the drive (the pending completion write queue (Fig.

1, element 170) is used to queue pending commands from the device driver – column 7, lines 35-45); and

periodically causing the drive to flush its cache to cause data cached in the cache of the drive and associated with the rebuild commands to be transmitted to the first non-volatile memory of the drive (col. 7, lines 35-42 – the write cache is periodically flushed to the drive), comprising the steps of:

maintaining a count in the drive controller of the number of commands stored in the second memory of the drive controller (the device driver queue tracks the number of commands queued in the pending completion write queue – col. 7, lines 35-67), and

causing the drive to flush its cache when the count of the number of commands stored in the second memory of the drive controller reaches a predetermined threshold wherein each rebuild command directed to drive is at least temporarily recorded in the second memory during the period that the cache of the drive is enabled (the write cache is enabled to improve write performance, and subsequently flushed when the host runs out of commands (i.e. the maximum queue depth is achieved (i.e.256) – col. 7, lines 35-67)).

Despite these teachings, Horst fails to teach wherein the predetermined threshold is less than the maximum number of commands that may be recorded in the second non-volatile memory of the drive controller.

Bogin however teaches a method and apparatus for write cache flush and fill mechanisms in which cache entries are flushed from the cache based on a threshold exceeding a "low threshold" (i.e., one lower than the maximum number of entries in the cache) – paragraph 0037, all lines.

It would have been obvious to one of ordinary skill in the art at the time of the invention for Horst to further include Bogin's cache flushing apparatus into his own apparatus with activity bins for increasing the performance of disk arrays. By doing so, Horst could exploit the benefits of a more efficient caching system which avoids conventional deficiencies (e.g., lack of efficiency due to sequential operation, etc.) of caching as taught by Bogin in paragraphs 0009-0012, all lines.

As for claim 10, Horst teaches a method for rebuilding storage media of a drive, wherein the drive is in communication with a drive controller and a write cache that may be selectively enabled, the method comprising:

enabling the write cache for the drive (col. 7, lines 35-52 – the cache is enabled);

transmitting one or more commands to the drive from the drive controller (the host (Fig. 1, element 102) sends commands to the array controller (Fig. 1, element 100) – col. 5, lines 25-47);

writing the one or more commands to a journal located in the drive controller (the pending completion write queue (Fig. 1, element 170) is used to queue pending commands from the device driver – column 7, lines 35-45);

providing a count of commands sent to the drive, wherein the count is located in the drive controller (commands from the host are queued in the pending completion write queue (i.e. the number of commands stored = the count of commands sent from the host – col. 7 35-67));

forcing the drive to flush the data in the write cache to the storage media (the write cache is flushed to the drives – col. 7, lines 35-52); and

wherein the step of forcing the drive to flush data in the write cache is performed once the count of commands sent to the drive reaches a predetermined value (the write cache is enabled to improve write performance, and subsequently flushed when the host runs out of commands (i.e. the maximum queue depth is achieved (i.e.256) – col. 7, lines 35-67)).

Despite these teachings, Horst fails to teach wherein the predetermined threshold is less than the maximum number of commands that may be recorded in the second non-volatile memory of the drive controller.

Bogin however teaches a method and apparatus for write cache flush and fill mechanisms in which cache entries are flushed from the cache based on a threshold exceeding a "low threshold" (i.e., one lower than the maximum number of entries in the cache) – paragraph 0037, all lines.

It would have been obvious to one of ordinary skill in the art at the time of the invention for Horst to further include Bogin's cache flushing apparatus into his own apparatus with activity bins for increasing the performance of disk arrays. By doing so,

Horst could exploit the benefits of a more efficient caching system which avoids conventional deficiencies (e.g., lack of efficiency due to sequential operation, etc.) of caching as taught by Bogin in paragraphs 0009-0012, all lines.

As for claim 18, Horst teaches a drive controller operable to communicate with a drive through a communications channel, comprising:

a first memory for recording commands transmitted from the drive controller to the drive during a period that the drive is being rebuilt (the first memory is depicted in Fig. 1, elements 126, 128 and 180, the pending completion write queue (Fig. 1, element 170) is used to queue pending commands from the device driver – column 7, lines 35-45);

a second memory for storing a count of the commands recorded in the first memory (the device driver's queue functions as a counter by issuing commands to the pending completion write queue until it reaches its maximum depth (i.e. 256) - col. 7, lines 35-67);

wherein, during the period that the drive is being rebuilt, the drive controller is operable to enable the write cache of the drive and cause the drive to flush the data in a write cache of the drive when the count of the commands reaches a predetermined threshold (the write cache is enabled to improve write performance, and subsequently flushed when the host runs out of commands (i.e. the maximum queue depth is achieved (i.e.256) – col. 7, lines 35-67).

Despite these teachings, Horst fails to teach wherein the predetermined threshold is less than the maximum number of commands that may be recorded in the second non-volatile memory of the drive controller.

Bogin however teaches a method and apparatus for write cache flush and fill mechanisms in which cache entries are flushed from the cache based on a threshold exceeding a "low threshold" (i.e., one lower than the maximum number of entries in the cache) – paragraph 0037, all lines.

It would have been obvious to one of ordinary skill in the art at the time of the invention for Horst to further include Bogin's cache flushing apparatus into his own apparatus with activity bins for increasing the performance of disk arrays. By doing so, Horst could exploit the benefits of a more efficient caching system which avoids conventional deficiencies (e.g., lack of efficiency due to sequential operation, etc.) of caching as taught by Bogin in paragraphs 0009-0012, all lines.

As for claims 11 and 14, Horst teaches the drive controller as being operable to clear its first memory following the indication of the successful flushing of data in the write cache of the associated drive (the pending complete write queue is cleared once flush is complete – col. 7, lines 35-53).

As for claims 2 and 12, Horst teaches disabling the write cache of the drive following the successful rebuild of the drive (the write cache is enabled to queue commands prior to the flush operation - col. 7, lines 35-52; the cache is therefore disabled upon the completion of a successful rebuild of the drive once the flush is complete)).

As for claim 4, Horst teaches clearing the second memory and the count following the successful flushing of the cache to the first non-volatile memory (col. 7, lines 35-42 – the data is flushed to the cache)

As for claim 16, Horst teaches clearing the journal after the drive flushes all data in the write cache and transmits a message indicating that the cached data was written to the storage media (col. 7, lines 35-67 – the host receives the completion interrupts after the cache was flushed to indicate the data has been flushed, therefore the journal may be cleared)

As for claim 17, Horst teaches the journal as being comprised of non-volatile memory (Fig. 1, elements 126, 128 and 180 comprise non-volatile memory).

As for claim 19, Horst teaches the drive controller as being operable to disable the write cache of the drive following the successful rebuild of the drive (the write cache is enabled to queue commands prior to the flush operation - col. 7, lines 35-52; in other words, it is operable to disable the cache upon the completion of a successful rebuild of the drive once the flush is complete).

As for claim 20, Horst teaches the first memory as comprising a non-volatile memory (the first memory (Fig. 1, element 126, 128, 180) comprises ROM memory for example (Fig. 1, element 126)).

6. Claims 5, 6 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Horst (US Patent 6,567,892 B1) and Wu et al. (US PG Publication 2004/0117579

A1), hereinafter "Wu" and in further view of Bogin (US PG Publication 2004/0024971 A1).

As for claim 5, Horst teaches a storage array, comprising:

multiple drives (Fig. 1, elements 110),

a write cache for caching data associated with write commands received by the drive (Fig. 1, element 132); and

drive controller (Fig. 1, element 120), wherein the drive controller is associated with and coupled to a drive of the storage array, wherein the drive controller comprises a first memory ((Fig. 1, elements 126, 128 and 180), wherein the first memory is operable to store a history of write commands transmitted from each drive controller to its associated drive (the pending completion write queue (Fig. 1, element 170) is used to queue pending commands from the device driver – column 7, lines 35-45)); and

wherein each drive controller is operable to manage the rebuild of its associated drive by:

enabling the write cache for the drive (col. 7, lines 35-52 – the cache is enabled);

recording each write command sent to the drive in the first memory (the pending completion write queue (Fig. 1, element 170) is used to queue pending commands from the device driver – column 7, lines 35-45);

periodically causing the drive to flush the data in the write cache of the drive (data is flushed to the drive - col. 7, lines 35-67); and

disabling the write cache for the drive upon the successful completion of the rebuild of the drive (the write cache is enabled to queue commands prior to the flush operation. The cache is disabled once the flush occurs - col. 7, lines 35-52);

a second memory for recording the number of commands stored in the first memory (the device driver queue tracks the number of commands queued in the pending completion write queue – col. 7, lines 35-67), and wherein each drive controller is operable to cause its associated drive to flush the data in the write cache when the number of commands stored in the first memory reaches a predetermined threshold (the write cache is flushed when the host runs out of commands (i.e. the maximum queue depth is achieved (i.e.256) – col. 7, lines 35-67)).

Despite these teachings, Horst fails to teach each drive as comprising a write cache (rather Horst teaches only one write cache in the array controller), and each drive controller as comprising a first memory (rather Horst teaches his one array controller as comprising a first memory). Horst further fails to teach each drive controller as comprising a second memory. Horst however does teach an embodiment where a single disk drive and controller unit can be used in place of the array controller (i.e. all the structural elements of the array controller as presently depicted in Fig. 1 are contained within a single disk controller which is solely responsible for serving one disk drive – col. 5, lines 12-24). Despite these teachings, Horst fails to teach multiple

controllers, wherein each controller is associated with a drive as presently recited by Applicant.

Wu however teaches system and method for implementing shared memory regions in distributed shared memory systems, wherein each drive controller (Fig. 1, elements 14A and 14B), is associated with a single drive (Fig. 1, elements 16A and 16B) – paragraph 0032, all lines.

It would have been obvious to one of ordinary skill in the art at the time of the invention for Horst to further include Wu's system for implementing shared memory regions in distributed shared memory systems. By doing so, Horst would be able to exploit the benefits of cache mirroring and write cache coherency, which in turn would improve his system's overall reliability as taught by Wu in paragraphs 0007 and 0008, all lines.

Further despite these teachings, Horst fails to teach wherein the predetermined threshold is less than the maximum number of commands that may be recorded in the second non-volatile memory of the drive controller.

Bogin however teaches a method and apparatus for write cache flush and fill mechanisms in which cache entries are flushed from the cache based on a threshold exceeding a "low threshold" (i.e., one lower than the maximum number of entries in the cache) – paragraph 0037, all lines.

It would have been obvious to one of ordinary skill in the art at the time of the invention for Horst to further include Bogin's cache flushing apparatus into his own apparatus with activity bins for increasing the performance of disk arrays. By doing so,

Horst could exploit the benefits of a more efficient caching system which avoids conventional deficiencies (e.g., lack of efficiency due to sequential operation, etc.) of caching as taught by Bogin in paragraphs 0009-0012, all lines.

As for claim 6 Horst teaches the drive controller as being operable to clear its first memory following the indication of the successful flushing of the data in the write cache of the associated drive (the pending complete write queue is cleared once flush is complete – col. 7, lines 35-53).

As for claim 9, Horst teaches the first memory as being non-volatile (Fig. 1, elements 126, 128 and 180 comprise non-volatile memory).

Response to Arguments

7. Applicant's arguments have been fully considered, however they are rendered moot in view of the new grounds of rejection presented above.

Conclusion

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Craig E. Walter whose telephone number is (571) 272-8154. The examiner can normally be reached on 8:30a - 5:00p M-F.

9. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Hyung S. Sough can be reached on (571) 272-6799. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

10. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Craig E Walter/
Patent Examiner, Art Unit 2188

CEW